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First Semester B.E. Degree Examination, Dec.2014/Jan.2015

Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs.

Max. Marks:100

Note: Answer FIVE full questions, selecting
at least ONE question from each part

PART 1

Briefly explain the role of civil engineers in the infrastructural development. (10 Marks)

In the triangle ABC, a force at 'A' produces a clockwise moment of 90 kN-m at B and an anticlockwise moment of 45 kN-m at C. Find the magnitude and direction of the force. (06 Marks)

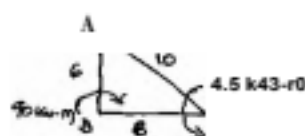


Fig. Q1 (b),



Fig.

a

C. Define force and its characteristics. (04 Marks)

2 a. Explain the following With neat sketches: i) Principle of superposition of forces.

ii) Principle of transmissibility of forces. iii) Couple and its characteristics. (10 Marks)

b. Draw typical cross section of a road and explain the parts. (10 Marks)

PART 2

3 a. Four co-planar forces acting at a point are shown in Fig. Q3 (a). One of the forces is unknown and its magnitude is shown by 'P'. The resultant has a magnitude of 500 N and is acting along the x-axis. Determine the unknown force 'P' and its inclination with x-axis. (08 Marks)

b. State and prove Varignon's theorem of moments. (06 Marks)

c. State and prove parallelogram law of forces. (06 Marks)

4 a. Determine the magnitude, direction of the resultant force for the force system as shown in Fig. Q4 (a). Locate the resultant force with respect to point D. (08 Marks)

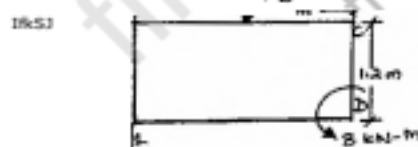


Fig. Q4 (a)

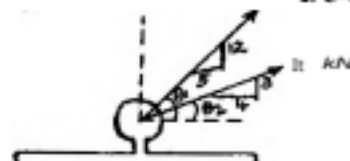


Fig. Q4 (b)

26 kN force is the resultant of the two forces, one of which is as shown in Fig. Q4 (b). Determine the other force. (08 Marks)

c. Explain the principle of resolved parts. (04 Marks)

PART 3

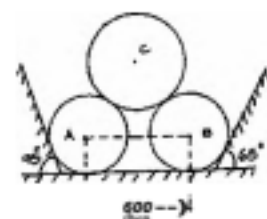
 a. Determine the reactions at contact points for spheres A, B and C as shown in Fig. Q5 (a). It is given that $W_A = W_B = 4 \text{ kN}$, $W_C = 6 \text{ kN}$, $d_A = d_B = 500 \text{ mm}$, $d_C = 800 \text{ mm}$ (12 Marks)


Fig. Q5 (a)

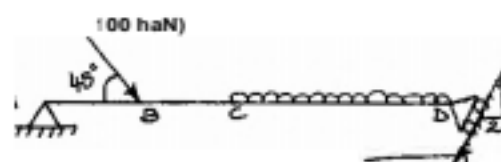


Fig. Q5 (b)

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b. For the beam with loading shown in Fig. Q5 (b), determine the reactions at the supports.

(08 Marks)

6 a. State and prove Lami's theorem.

(08 Marks)

b. The ladder shown in Fig. Q6 (b) is 4 m long and is supported by a horizontal floor and vertical wall. The co-efficient of friction at the wall is 0.25 and at the floor is 0.50. The weight of the ladder is 200 N, considered concentrated at 'G'. The ladder supports a vertical load of 1000 N at 'C'. Determine the reactions 'A' and 'B' and compute the least value of 'a' at which, the ladder may be placed without slipping.

(08 Marks)



Fig. Q6 (b)

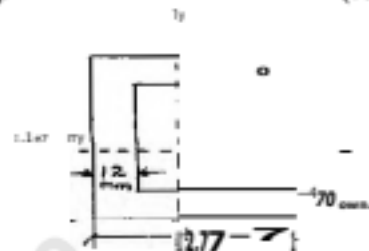


Fig. Q7 (b)

c. State laws of friction.

(04 Marks)

PART — 4

7 a. Determine the centroid of a semi-circular lamina of radius 'R' by method of integration.

(08 Marks)

b. Determine the moment of inertia of the section shown in Fig. Q7 (b) about its centroidal axes. Calculate the least radius of gyration for the section as well.

(12 Marks)

8 a. State and prove parallel axis theorem

(06 Marks)

b. Locate the centroid of the shaded area as shown in Fig. Q8 (b).

(08 Marks)

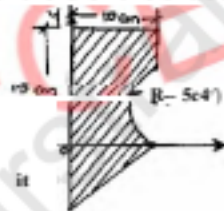


Fig. Q8 (b)



Fig. Q9 (b)

c. Derive an expression for moment of inertia of a triangle with respect to horizontal centroidal axis.

(06 Marks)

PART — 5

9 a. What is centrifugal force? What is super elevation?

(04 Marks)

b. Determine the position at which the ball is thrown up the plane will strike the inclined plane as shown in Fig. Q9 (b). The initial velocity is 30 m/s and angle of projection is $\tan^{-1} \left(\frac{3}{4} \right)$ with horizontal.

(08 Marks)

c. A stone is dropped from the top of the tower 50 m high. At the same time another stone is thrown up from the tower with a velocity of 25 m/s. At what distance from the top and after how much time the two stones cross each other?

(08 Marks)

10 a. What is a projectile? Define the following terms briefly: i) Angle of projection ii) Horizontal range iii) Vertical height iv) Time of flight.

(10 Marks)

b. A burglar's car starts at an acceleration of 2 m/s^2 . A police vigilant party came after 5 s and continued to chase the burglar's car with a uniform velocity of 20 m/s. Find the time taken in which the police van will overtake the car.

(10 Marks)